THE INFLUENCE OF PUTTY WASH IMPRESSION TECHNIQUE ON DIMENSIONAL ACCURACY OF 2 COMMERCIALLY AVAILABLE VINYL POLY SILOXANE IMPRESSION MATERIALS - AN INVITRO STUDY

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Certificate

*This is to certify that the dissertation titled "**THE INFLUENCE OF PUTTY WASH IMPRESSION TECHNIQUE ON DIMENSIONAL ACCURACY OF 2 COMMERCIALLY AVAILABLE VINYL POLY SILOXANE IMPRESSION MATERIALS - AN INVITRO STUDY**" is a bonafide record of work carried out under my guidance by* **Dr. M. KANMANI** *during the period of 2004-2006. This dissertation is submitted in partial fulfillment for the degree of Master of Dental Surgery awarded by Tamil Nadu Dr. M.G.R. Medical University, Chennai in the branch of Prosthodontics. It has not been submitted partially or fully for the award of any other degree or diploma.*

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CONTENTS

INTRODUCTION

Impression is an imprint of the teeth and adjacent structures for uses in dentistry. Impression materials in one substance or combination of substances are used for making an impression or negative reproduction. Various impression techniques are used in making a negative likeness (GPT-4).

History reveals that waxes were used as an Impression material during 18th & 19th century. Later in 19th century plaster and compound were used for making impression. But both plaster and compound do not have sufficient elastic property to register the undercut areas[79,80].

In various stages Agar, Zinc Oxide Eugenol, alginate and elastomers were developed for impression making. These materials have been modified chemically and physically for use in dentistry. Initially elastomer group consisted exclusively of polysulfide & condensation silicone impression material[24].

Polysulfide and condensation silicone impression materials sets by an condensation polymerization reaction leading to release of volatile by products which there by causes shrinkage[11,17,24,85,].

In 1960, Elastomers like polyether and addition reaction silicone or vinyl poly siloxane impression materials were introduced. They are widely used for obtaining dimensionally accurate impression particularly for crown and Bridges.

In contrast to polysulfide & condensation siloxane impression materials, vinyl poly siloxane sets by an addition polymerization reaction without the production of volatile by product. The significance of accuracy in the process of fabricating restorations should be understood[24].

Elastomeric impression materials are subject to dimensional changes in several factors, like the process of polymerization in which it involves cross linking of the polymer chains, can result in a reduction of spatial volume. Continuous polymerization reactions take place even after removal of the impression. The changes due to the effect of temperature, influence of material volume, bulk of the material. The condition under which the material stored and disinfection of impression[8,26,30,46,108].

Clinical techniques involved with impression making have been extensively investigated and potential consequences also have been reported[3,7,39].

There is much discussion in the dental literature regarding the effect of the impression technique on accurate fit of cast restorations. An accurate impression technique will result in precise fitting cast restoration. This is one factor that determines the restorations longevity. Impression materials have improved to such an extent on accuracy more with technique than by the material itself. Further more, the "WASH THICKNESS" is also an essential factor that influences the accuracy of elastomeric impression materials[24,28,30,58,68,69,70].

Several techniques have been suggested to improve the accuracy of vinyl polysiloxane impressions. One step or two step putty wash technique are the technique mostly used. The two step technique usually required a spacer to provide space for the wash material. A number of spacer technique have been evaluated in literature. This invitro study was conducted to compare the accuracy of 1&2 step technique using various types of spacers.

AIM OF THE STUDY

The aim of the study is to assess the

1) Accuracy of 2 commercially available vinyl poly siloxane impression materials.

2) Accuracy among one step putty wash and 2 step putty wash impression technique for the two impression materials.

3) Accuracy within 2 step putty wash impression technique employing various forms of spacers such as

   a. Polyethylene sheet

   b. Scrapping

   c. Coping

REVIEW OF LITERATURE

A cast cannot contain more information than the impression from which it is made[62]. From the day when the first impression was made until now there has always been a quest for a material that gives an exact reproduction of the details. Numerous research have been conducted and their results analysed to determine the best material and the best impression technique.

Robert S. Lewebke, et al (1979)[87] assessed the effect of delayed and second pours on elastomeric impression material accuracy overall no significant difference was found in accuracy between first and second pours.

Finger W, Ohsawa M. (1983)[33] Accuracy of stone-casts produced from selected addition type silicone impressions and concluded that there is no correlation between the free curing contraction of three selected addition-type silicone impression materials and the effective contraction determined as the accuracy of stone dies produced in dental impressions of these materials. Depending on specific rheologic properties, the free curing contraction of an impression material can be partly compensated for by flow. Five vinyl polysiloxane addition curing impression materials were evaluated on the basis of linear dimensional change occurring as a function of time between making an impression and pouring the die. The dies were measured and compared to a master model to determine the linear change in the impression material. One material produced an overall larger die, but the greatest increase in size deviated from the master model by only 0.1%. Permagum putty-wash material consistently produced undersized dies, with the greatest change being 0.3%. Three materials randomly produced smaller or larger dies, differing from the master model by only 0.08% for the smallest die to 0.07% for the largest. No consistent pattern of increase or decrease in die size occurred with time. Dies produced at 168 hours were as accurate as those produced at 10 minutes.

de Araujo PA, Jorgensen KD (1985)[26] assessed effect of material bulk and undercuts on the accuracy of impression materials. A truncated cone-shaped chromium steel die was used to determine the influence of the bulk of elastomeric impression material and size of undercut on the dimension of stone dies. It was found that both conditions affect the accuracy of stone dies. The possible clinical implications of the inaccuracies were discussed.

Craig RG (1985)[23] evaluated automatic mixing system for an addition silicone impression material. The automatic mixing system of an addition silicone impression material yields mixes and set material that comply with ADA specification no. 19 when testing is started at 0.5 minute rather than the specified 1.5 minutes. This change is reasonable because there is zero mixing time rather than the usual 45-60 second needed for standard two-paste rubber impression materials. Uniform mixing of base and catalyst occurs with the automatic system, with a fourth to a fifth as many bubbles in the mix as for comparable mixes obtained by hand spatulation. The properties and accuracy of the system are excellent and typical of addition silicones, including excellent recovery from deformation, low dimensional change on setting, and low flow. A wash or two-phase impression technique may be used with equal clinical accuracy.

Johnson GH, Craig RG (1986)[46] assessed the accuracy of both addition and condensation silicones produced stone dies that were larger in diameter and shorter in height than the tooth preparation. For both materials, there was little change in the distance between stone die preparations compared with the standard. The most significant difference between types of silicone was that condensation silicones produced significantly shorter dies (-0.24% to -0.37%) than addition silicones (-0.08%). Among addition silicones Cinch produced more than twice a much vertical change (-0.16%) than other three products (-.06%), Since castings made from a short die will not seat completely on the prepared tooth these results support the use of three of the four addition silicones tested.

de Araujo PA, Jorgensen KD (1986)[27] assessed the improved accuracy by reheating addition-reaction silicone impression. Addition-reaction silicone impressions were made at 37 degrees C in ‘two cylindrical trays of a truncated-cone-shaped chromium-steel die. One tray size was used to obtain impressions with 1 mm thickness from tray to the buccal and lingual surface of the steel die while the second tray permitted a thickness of 4 mm. Stone dies were made from impressions after (1) cooling to 22 degrees C for 10 minutes or (2) cooling to 22 degrees C for 10 minutes and reheating to 37 degrees C for 30 minutes. Results revealed that reheating the impressions to mouth temperature before pouring the dies improved their accuracy.

Roger E. Johnson, et al (1987)[89] assessed the dimensional changes of elastomers during cold sterilization. The addition reaction vinyl poly siloxane materials demonstrated great stability during both wet and dry storage.

Jack D. Gerrow, Robert L Schaider (1987)[40] compared the compatibility of elastomeric materials, type IV dental stones and liquid media on the basis of the reproduction of surface detail on a test cast. The result of this investigation suggest that care not be taken to choose compatible impression materials and dental stones.

Chee WW, Donovan TE (1989)[17] studied the effect of very high viscosity (putty) polyvinyl siloxane impression material with both the conventional double-mix and single-mix putty wash technique. Three of the materials reproduced the 20 microns groove in one half of the samples tested, while the remainder failed to do so.

Murakami H, Takechana S, Abe T, Tejima R (1989)[67] evaluated the dimensional change and deformation on stone dies made by different impression methods using vinyl silicone impression materials and concluded, it made no difference what kind of vinyl silicone impression materials were used.

Marshak B et al., (1990)[58] assessed that a precise impression is imperative for the construction of an accurately fitting indirect cast restoration. The putty wash technique is commonly used in making impression with silicone impression in this study a technique is presented ensuring exact reseating of the putty impression tray and creation of a uniform wash space which are essential for accurate results.

Soh G, Ghong YH (1991)[96] evaluated the relationship of viscosity to porosities in automixed elastomeric impression technique and concluded that putty wash impression generated significantly less voids than medium viscosity impressions for all materials. The finding of these study suggested that putty wash impression produced significantly less porosities than medium viscosity impression and consequently offer better tear strength for impression.

Pfeiffer P, et al (1991)[78] evaluated the bond between the wash elastomer and putty silicones and concluded that bond strength decreased, when putty material was contaminated with saliva and dried before adding the wash elastomer. When putty silicones were rinsed and dried after contamination with saliva bond strength increased upto 80-90%.

Tait CM, Rosen M, et al., (1991)[98] evaluated the effects of impression technique on accuracy of stone models and concluded that the putty wash plus putty wash spacer techniques both give accurate impression. This study was designed to compare the accuracy of initial and repour models obtained from an impression recorded in a hydrophilic addition curing silicone and determine whether or not this accuracy is affected by the impression technique employed and whether any inter action between impression techniques and levels of pour existed.

Dennis R. curren, Jess U. Mikerul and James sandrik in (1991)[28] assessed the relationship of the wettability of an elastomeric impression material and its interaction with the gypsum shurry is an improvement factor. This study examined the relative pourability of several impression materials by counting the number of resultant voids in artificial stone casts.

Mohd Zainal et al (1991)[65] assessed the properties of tray adhesive of an addition polymerizing silicone to impression tray materials.

Tjan AH et al., (1992)[102] evaluated the dimensional accuracy and bond strength of addition silicones. A cross matching study was conducted to evaluate the effect on dimensional accuracy and tensile bond strength between the materials when intermixing branch of addition silicone impression materials in a putty wash impression and concluded that the actual differences in percent deviation between the intermixed groups and their respective reference groups are very small, they are presumed to be insignificant clinically.

Hung SH et al (1992)[39] compared the accuracy of one step versus 2 step putty wash addition silicone impression technique. 5 addition silicone impression materials were tested. Accuracy of addition silicone impression material is affected more by material than technique. Accuracy of the putty wash one step impression technique except at one of the six dimensions where one step was more accurate than 2 step.

Janice P. Donald et al., (1994)[42] assessed the bond strength between putty impressions and subsequent wash applications. The effect of a disinfectant on the bond strength between a disinfected putty impression and a subsequent wash applications was evaluated to simulate perfecting a disinfected final impression clinically.

Abuasi HA et al., (1994)[3] investigated the accuracy of one stage polyvinyl siloxane impressions recorded in metal and plastic stock trays using regular and soft putties and concluded that the putty wash plastic tray combination is unsatisfactory. Metal trays reduce in distortion with some putty wash systems but not with others.

Bard Idris et al (1995)[7] compared the putty wash one step and 2 step technique for making addition silicone impression. For each technique 15 impressions were made of a stainless steel base to which 3 tapered posts were attached. Stone models were made of all impressions. The results indicated that the interabutment distances increased slightly compared with the stainless steel model for both techniques, but the differences between techniques were not considered to be clinically important. The intraabutment measurements for the abutment without undercut increased, whereas abutments with undercuts decreased. These variations from the stainless steel model were also clinically insignificant.

Johnson GH, Craig RG (1995)[45] assessed the accuracy of four types of rubber impression materials compared with time of pour and a repeat pour of models. The accuracy of four types of elastomeric impression materials was studied as a function of model location, time of pouring. and repetition of pouring. There was little change in dimension among abutment preparations for all materials, for all times of pour, and with a repeat pouring.

Tan E, Chai J et al., (1996)[99] evaluated the dimensional accuracy of polyvinyl siloxane impression material by evaluating the dimensional accuracy of stone dies of impression of a standard model made at successive time intervals and concluded that working time with this method generally were about 30 seconds longer than there recommended by the manufacturer.

Richards MW et al., (1998)[84] assessed the dimensional accuracy of one step putty wash impression technique using the one step polyvinyl siloxane impression technique, this study compared the effect of putty material working time on the dimensional accuracy of recovered improved stone casts.

Corso M et al., (1998)[21] evaluated the dimensional changes of poly vinyl siloxane impression materials as a function of storage temperature and concluded storing both impression materials at 4 degree C for 24 hours and then allowing the impression to reach room temperature resulted in a slightly expanded impression that partially compensated for the contraction that occurred from polymerization shrinkage.

Penaflor CF et al., (1998)[74] compared dimensional accuracy of single mix, double mix with spacer, double mix with cut out and double mix impression technique using addition silicone impression material and concluded that the double with cut out and double mix technique presents the least difference from the master model as compared to the other technique.

Eriksson A, Oekert et al., (1998)[31] evaluated the accuracy of addition silicone impression by using syringe tray technique and concluded that mechanical mixing without a vacuum and a tray designed similar to a perforated stock tray gave most accurate impression.

Richards MW, Zeiaci S, Bagby MD, Okabo (1998)[84] compared the effect of putty material working time on the dimensions accuracy of recovered improved stone. The impression were poured improved stone and vertical and horizontal measurements were made to 0.001 mm between reference points on recovered casts using an optical traveling microscope and concluded no statistically significant difference found among casts for all materials and time period tested.

Nissan DMD, (2000)[70] ***et al.,*** assessed the accuracy of 3 putty wash impression techniques using the same impression material (polyvinyl siloxane) in a laboratory model. For each technique, 15 impression were made of a stainless steel master model that contained 3 complete crown abutment preparation, which were used as a positive control. Accuracy were assessed by measuring 6 dimensions (interabutment and intraabutment) on stone dies poured from impression of the master model. Overall discrepancies of the 2 step technique with 2 mm relief putty wash impression technique were significantly smaller than that in the 1 step.

Fenske C (2000)[32] evaluated the influence of five impression techniques on the dimensional accuracy of master model and concluded that double mix technique is recommended for impression of supra gingival preparations.

Hondrum SO (2001)[38] assessed the changes in the properties of non aqueous elastomeric impression materials over time and on exposure to various environmental conditions and concluded that data for the addition reaction silicone impression material changed little during the 72 month testing period thus the material considered as storage stable.

Lamy M, et al (2001)[52] assessed the impression technique which allows to obtain in a single stage the impression of the abutment as well as their neighbouring teeth. The impression technique described was the double mix method. This method is based on the use of 2 elastomers with different viscosities, but form the same group thus allowing a simultaneous polymerization.

Cox Jr, Brandl RL, Hughes HJ (2002)[22] evaluated the dimensional accuracy of elastomeric impression, 35 addition silicone impression were made of cast metal copings cemented onto natural teeth prepared as complete crown abutments. The impression were poured in type IV die stone. Buccolingual and Inter abutment dimensions were measured the plastic double arch tray loaded with heavy viscosity addition silicone and a low viscosity wash produced the least accurate combination inter and intra abutment dimensions and concluded the more rigid tray impression material combinations more accurately replicated stone dies.

Nissan J et al (2002)[69] evaluated the amount of wash necessary to achieve accurate stone model while using a 2 step putty wash impression technique with polyvinyl siloxane (PVS) impression for each wash thickness (1,2 & 3mm) and concluded. The overall discrepancies of the groups using wash thickness of 1 and 2 mm were smaller than the group with 3 mm wash thickness. Therefore wash bulks of 1& 2 mm were most accurate for fabricating stone die using poly vinyl siloxane impressions.

Thongthammachat S et al., (2002)[101] evaluated the influence on dimensional accuracy of dental casts made with elastomeric impression materials and concluded that accurate casts can be made with either stock trays or custom trays. Silicone impression material has better dimensional stabilities.

Omar R, Abdullah MA, Sherfudhin H. (2003)[72] compared the accuracy of stone models obtained from 2 stage, pre spaced putty wash impression under conditions in which known volumes of wash material were introduced during the second stage of the impression. It is concluded that putty recoil, resulting from compression by excess wash material, plays a significant role in the undersizing of working dies, although the level of clinical relevance is less clear.

Petrie CS, Walker MP (2003)[77] assessed the dimensional accuracy of 2 hydrophilic VPS impression materials, when used under dry, moist and wet conditions.

Rodrigues Filbo LE et al (2003)[88] assessed the handling of vinyl polysiloxane impression putties with latex gloves and said to interfere with the setting of these impression materials. The aim of this study is to evaluate the effect of handling technique on the setting of vinyl polysilaxane impression putties using several types of gloves and concluded that setting inhibition depends on the kind of vinyl polysiloxane impression material and the kind of gloves used, but when the initial mixing was performed with the spatula this setting inhibition was over come.

Cynthia S. Petrie, et al (2003)[25] assessed the dimensional accuracy of 2 hydrophilic vinyl polysiloxane impression materials. The dimensional accuracy for both hydrophilic VPS impression materials was not significantly affected by the dry moist or wet environment.

Chen Sy, Liang WM et al (2004)[18] assessed accuracy of 5 commercially available silicone impression materials and concluded 2 addition type silicone material aquasil and Exaflex had the greatest accuracy.

Lampe I, Marton S et al (2004)[51] assessed the effect of mixing technique on shrinkage rate of 2 polyvinyl siloxane impression materials and concluded that they could not detect significant differences in dimensional changes when hand and cartridge - mix techniques were compared at the same measuring time for the tested polyvinyl siloxane material.

Donovan TE, Chee WW (2004)[29] outlines the ideal properties of impression materials and explains the importance of critical manipulating variable. Available impression materials are analysed relative to these variables and several “specialized” impression techniques are described. Special attention is paid to poly vinyl siloxane impression material because they have become the most widely used impression materials.

Rosner O et al., (2006)[91] compared different impression technique utilizing addition type polyvinyl siloxane for fabrication of tooth borne fixed partial dentures. The one step impression technique were no control of wash bulk and thickness exists is considered to be the least accurate impression method with measured discrepancies as large as 7 times the original inter preparation distance and 40 times the original cross arch dimensions and concluded that the 2 stage impression technique has proved to produce the most accurate and reliable impression due to complete control of the wash bulk.

Forrester - Baker L et al., (2005)[34] compared the dimensional accuracy between three different addition cured silicone impression materials and concluded that any change in measured dimensions occurring during impression making, was compensated for in some way by the casting process.

Wadhwani CP, Johnson GH et al (2005)[109] assessed the accuracy of 2 types of fast setting elastomeric impression materials. Differences detected were small and may not be of clinical significance.

Dimensions accuracy was measured by comparing the average length of the middle horizontal line in each impression to the same line on the metal die and concluded that there was no significant adverse effects on the dimensional accuracy of either material. Dimensional accuracy of both materials tested was well within ADA standards.

MATERIALS AND METHODS

The accuracy of the impression was evaluated indirectly by measuring several clinically relevant dimensions on gypsum casts recovered from impressions of a master model.

A machined standard mild steel die was made to serve as a model, which simulating 3 unit fixed partial denture. Reference lines were inscribed on the top and axial surfaces of abutments, which are used to assess the dimensional changes with help of traveling microscope.

A perforated tray was fabricated from the same mild steel. Orientation grooves were placed both on the tray and the metal model to ensure uniform seating for each-impression.

The materials used were listed in the tabular column as given below:

Materials	***Manufacturer***	***Consistency***
Addition Silicone	3M ESPE	i) Putty (7312) ii) Syringeable (7302) Low viscosity
Addition Silicone	Ivoclar vivadent virtual	i) Putty (Regular set) ii) Syringeable Low viscosity (Regular set)
Tray Adhesive	3M ESPE	
Tray Adhesive	Ivoclar vivadent virtual	
Die Stone	Ultra rock Type IV	

Methods:

For each technique 10 impression of the master model were made for 2 (Vinyl polysiloxane) materials.

These are grouping of the samples.

Group I (3m)	***Group II (Vivadent)***
Gr. I – A Gr. I – B Gr. I – C Gr. I – D	Gr. II – A Gr. II – B Gr. II – C Gr. II - D

Group I: 3M polyvinyl siloxane material used for Accuracy evaluation.

Group IA: Simultaneous one step putty wash impression techniques.

Group IB: 2 step putty wash polyethylene spacer impression technique.

Group IC: 2 Step putty wash scrapping impression technique

Group ID: 2 step putty wash 2mm coping impression technique.

Group II: Ivoclar vivadent virtual poly siloxane material used for accuracy evaluation.

Group IIA: Simultaneous one step putty wash impression technique.

Group IIB: 2 step putty wash polyethylene spacer impression technique.

Group IIC: 2 step putty wash scrapping impression technique.

Group IID: 2 step putty wash 2mm coping impression technique.

Impression materials were mixed in standardized proportions according to the manufacturer's recommendations. The tray adhesives were used evenly over the tray's surface.

GROUP IA: SIMULTANEOUS ONE STEP PUTTY WASH:

Impression Technique:

Here putty and wash impression materials were used simultaneously. Thin coat of 3M ESPE tray adhesive was applied on the tray and allowed to dry for minimum of 5 mts. Putty base and catalyst measured in equal volume and mixed until a homogenous colour is achieved within 30 seconds. The mixed putty was placed in a adhesive coated tray. Simultaneously the syringable low viscosity material was dispensed directly over the master model. The unset putty was placed over the low viscosity material and allowed to set for 12mts.

GROUP I B: 2 STEP PUTTY WASH POLY ETHYLENE SPACER IMPRESSION TECHNIQUE:

In this technique polyethylene spacer was placed over the master model when putty impression was taken and allowed to set for 10 mts. Later the tray was removed from the master model, polyethylene spacers was removed from the set putty material. Low viscosity material was then added into the tray on the set putty material, and allowed to set on the master model for 12 mts.

GROUP I C:
2 STEP PUTTY WASH SCARAPPING IMPRESSION TECHNIQUE:

In this technique preliminary impression was taken with putty impression material. Later final impression taken with low viscosity material. Thin coat of 3MESPE tray adhesive was applied on the tray and allowed to dry for minimum of 5 mts. Putty base and catalyst measured in equal volume and mixed until a homogeneous colour is achieved with in 30 seconds. The mixed putty was placed in an adhesive coated tray.

Then the tray with unset mixed putty was placed over the master model and allowed to set. To save time, the tray can be removed prior to complete set and allow the putty to set for a minimum of 10 mts. Later with sharp knife scrapping of the putty materials were done to get minimum 2 mm space. Syringeable material was dispensed on the scrapped putty impression in the tray. The tray was reseated and allowed to set on the master model for 12 mts.

GROUP ID:
2 STEP PUTTY WASH COPING IMPRESSION WITH 2 MM RELIEF:

In this technique mild steel prefabricated copings of 2 mm thick were placed on each abutment to create a uniform wash space[25]. The putty impression was made first and allowed to set for 10 mts. In the sound step, the copings were removed and the wash material was added. The impression material was allowed to set on the master model for 12 minutes.

All these same techniques were followed for impression making with Ivoclar Vivadent VPS impression material. They were considered as Group IIA, Group IIB, Gr. II C & Gr. II D.

Setting time, according to the manufacturers was doubled to compensate for impression making at room temperature instead of at mouth temperature.

All impressions were stored at room temperature for 1 hr as per manufacturer instruction. Type IV dental stone was mixed by hand spatulation as per the water powder ratio specified by manufacturer. The model was poured with improved stone.

All measurements from the master and stone models were measured with (a measuring) microscope suswax optic traveling microscope, capable of measuring upto 1 μm was used to measure the master and stone model.

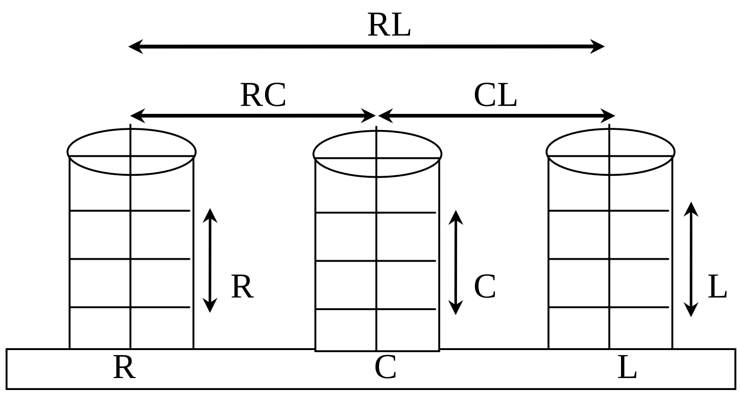


Diagram of master model displaying interabutment (RC, CL,RL) and Intraabutment (R,CL) measurement

Traveling Microscope has 2 main scales graduated on steel plates. One is fixed horizontally and another vertically to measure both the horizontal and vertical displacements of the microscope. These fixed main scales are provided with vernier which slide over main scale on moving the microscope. The model is placed on the horizontal base of the traveling microscope adjusted to view the model.

The vertical and horizontal crosswire is made to coincide with vertical & horizontal line on the model by moving the head slightly while viewing if the cross wire shifts with respect to the focussed point, then by pulling the eye piece slightly out or pushing in adjustment is made to avoid error.

Main scale and vernier scale reading (R_1) are taken. Then the microscope is moved along the same direction and the crosswire made to coincide with the line present in the next abutment of the model. Corresponding main scale and vernier scale readings (R_2) are taken.

The difference between these 2 readings (R_1 & R_2) gives the distance between the 2 posts in the model. In this study with this method distance between (R-C, C-L, R-L, R, C, L) distances are determined. Each distance on the stainless steel model at each measurement location was measured 10 times.

The mean and standard deviation or all distance measurements are calculated and used as the standard measurement for comparison between the 2 techniques with 2 materials.

DATA ANALYSIS:

The percentage deviation of each distance of the putty wash one step / 2 step technique from the stainless steel master model was computed by calculating difference between the mean of each distance on the stone models "MSM" and the mean of each corresponding distance on the master model multiplied by 100.

$$\text{Percentage deviation} = \frac{\text{MSM} - \text{MMM}}{\text{MMM x 100}}$$

One way analysis of variance (ANOVA) was used to compare the difference among the 4 putty wash impression techniques and between the 2 impression materials and the master model for each measurement.

Metal Master Die

3M PVS Putty Material

3M PVS Wash Material

IVOCLAR Virtual PVS Putty Material

IVOCLAR Virtual PVS Wash Material

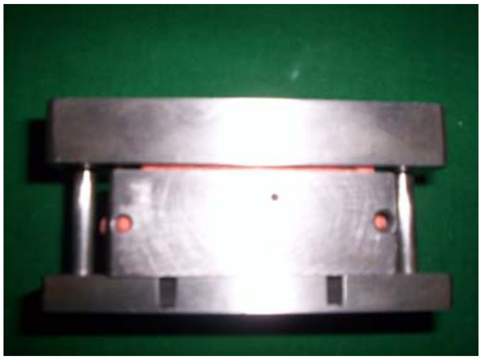
Type IV Dental Stone & Distilled Water

3M & Virtual Tray Adhesives

Cellophane Spacer

Four Putty WashTechniques of 3M PVS Material

Simultaneous One Step Putty Wash Technique



Two Step Polyethylene Spacer Technique

Two Step Scrapping Technique

Two Step Coping Technique

Four Putty Wash Techniques of Virtual PVS Material

Simultaneous One Step Wash Technique

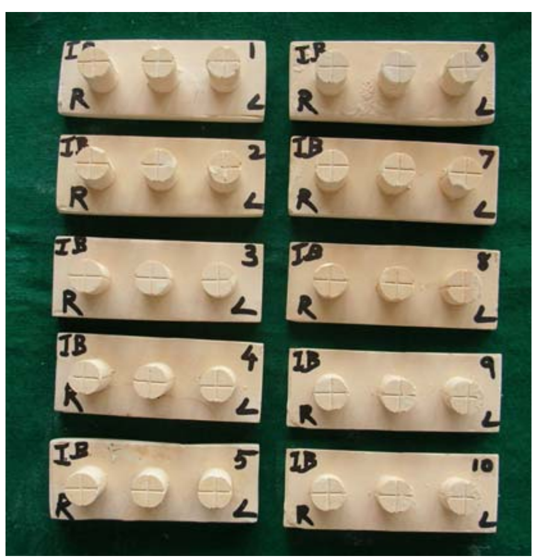
Two Step Putty Wash Putty Technique

Two Step Scrapping Technique

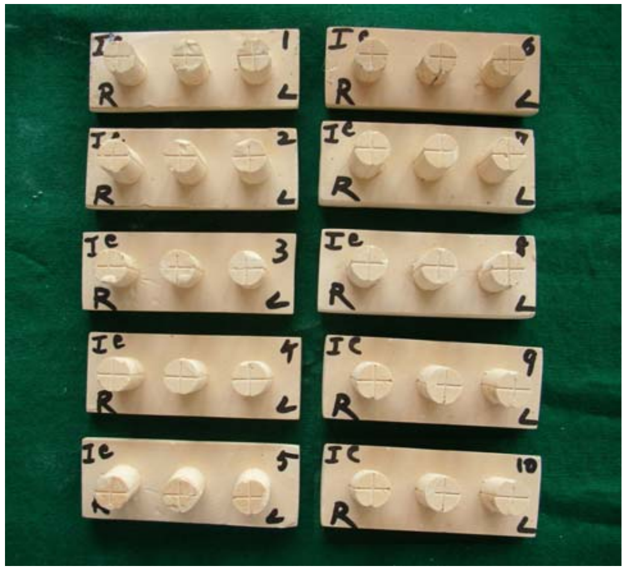
Two Step Coping Technique

Stone Model of Group I A

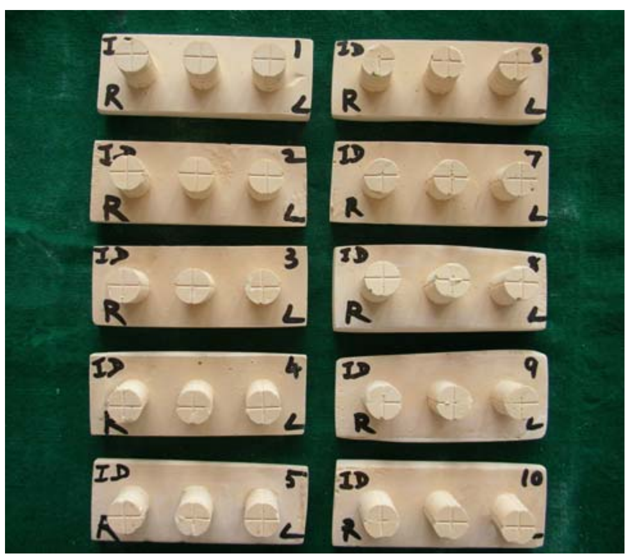
Stone Model of Group I B



Stone Model of Group I C



Stone Model of Group I D



Stone Model of Group II A

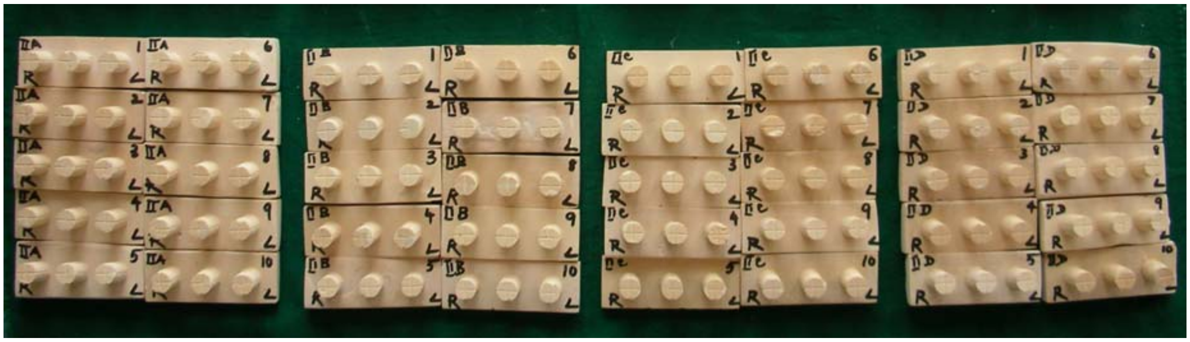
Stone Model of Group II B

Stone Model of Group I I C

Stone Model of Group I I D

Stone Models of Group I (ABCD)

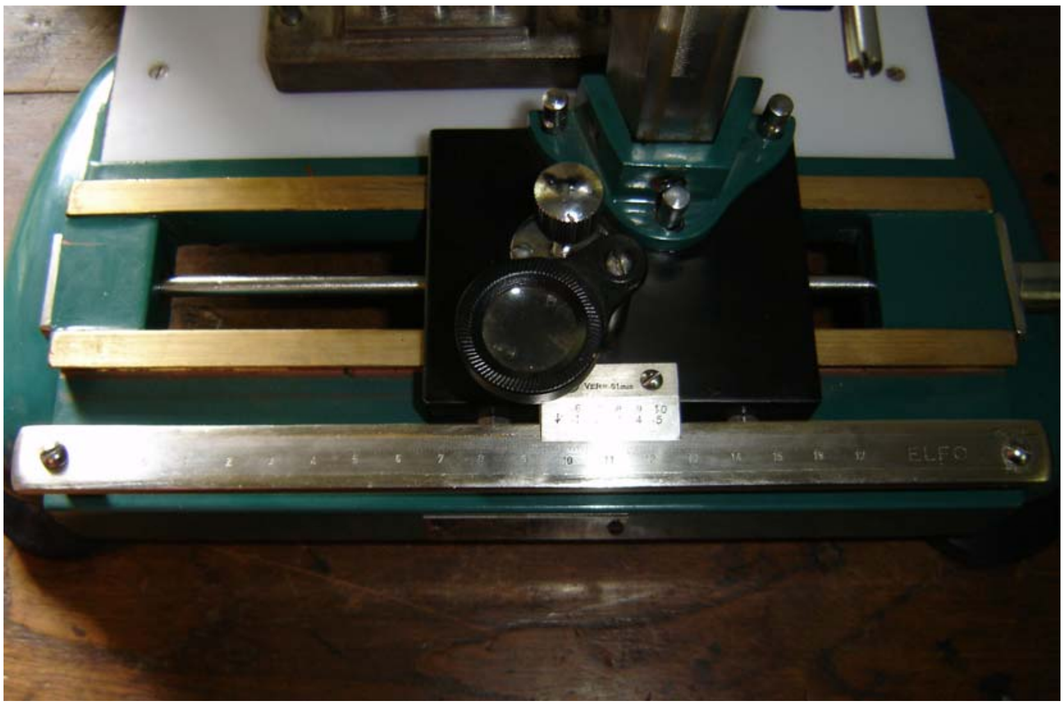
Stone Models of Group II (ABCD)



Stone Models of Group I&II (ABCD)

Traveling Microscope

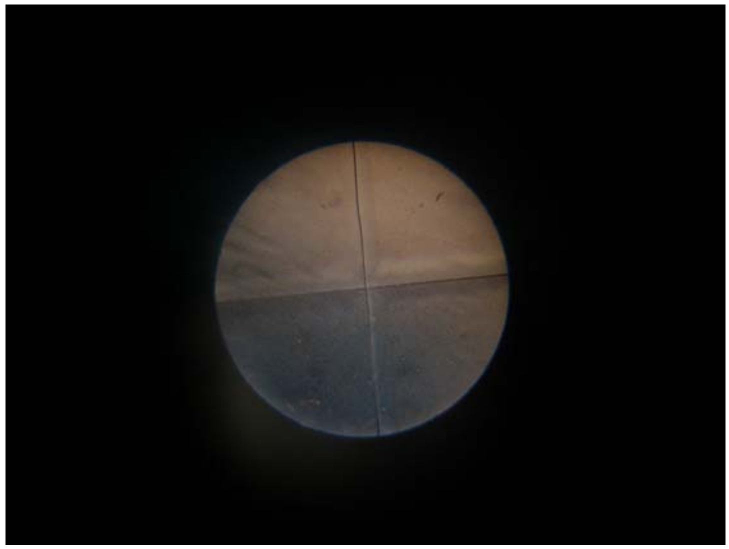
Main & Vernier Scale of Traveling Microscope



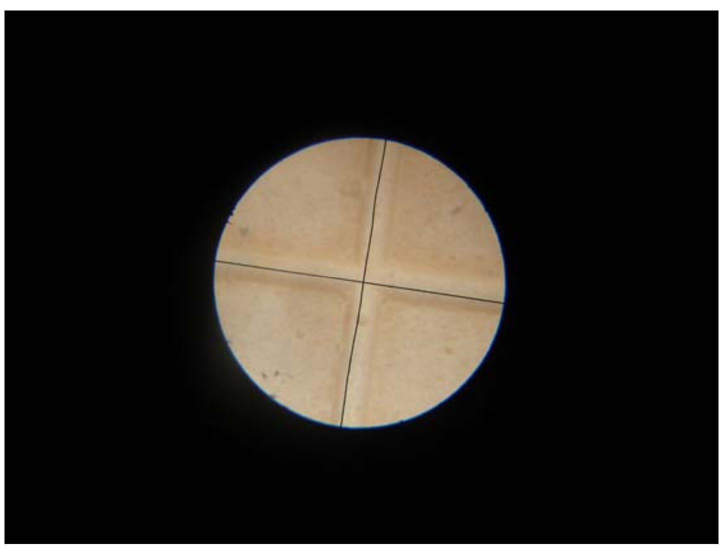
Master Model on the Traveling Microscope

Stone Model on the Traveling Microscope

Traveling Microscope View of Master Model



Traveling Microscope View of Stone Model



RESULTS

The present in vitro study was conducted to study the influence of putty wash impression technique on the accuracy of 2 polyvinyl siloxane impression material. The technique used in this study were simultaneous one step putty wash and 2 step putty wash technique with spacer. The 2 poly vinyl siloxane impression material used were 3 M PVS (Group I) ivoclar vivadent virtual PVS material (Group II).

The accuracy of impression material was assessed by comparing the measurements, intra-abutment & Inter-abutment obtained from master model with measurement of the stone model.

The results of the accuracy of the impression material obtained by measuring intra & inter-abutment distances is evaluated and tabulated (4.1 - 4.3). They were then subjected to statistical analysis.

Table (4.4 - 4.12) presents the mean, standard deviation, percentage deviation, absolute change in μm, one way ANOVA, Duncan's multiple range test, student 't' test for the accuracy of the impression material.

<u>Table. 4.1</u>
<u>Interabutment (RC, CL, RL) & Intraabutment (R,C,L) measurements of the master model</u>

S.No	RC	CL	RL	R	C	L
1.	1.553	1.606	3.159	0.736	0.731	0.736
2.	1.552	1.607	3.159	0.736	0.731	0.736
3.	1.552	1.606	3.158	0.734	0.730	0.737
4.	1.552	1.606	3.158	0.734	0.730	0.737
5.	1.553	1.607	3.160	0.734	0.729	0.736
6.	1.553	1.608	3.161	0.735	0.729	0.736
7.	1.554	1.608	3.162	0.735	0.731	0.738
8.	1.554	1.608	3.162	0.734	0.731	0.738
9.	1.554	1.606	3.160	0.736	0.729	0.738
10.	1.553	1.608	3.161	0.736	0.729	0.738
Mean	1.553	1.607	3.160	0.735	0.730	0.737

Each distance on the master model at each measurement location was measured 10 times & the mean was used as the control to compare distance on the stone model obtained by the four impression techniques.

Table 4.2 Interabutment (RC,CL,RL) & Intraabutment (R,C,L) measurement of the stone dies obtained from the groupI (3M PVS Material) using four different putty wash technique.

	Group IA						**Group IB**						
	Interabutment			**Intraabutment**				**Interabutment**			**Intraabutment**		
Model No	**RC**	**CL**	**RL**	**R**	**C**	**L**	**Model No**	**RC**	**CL**	**RL**	**R**	C	L
1.	1.553	1.422	2.975	0.696	0.624	0.711	1.	1.447	1.653	3.100	0.717	0.676	0.717
2.	1.542	1.421	2.963	0.695	0.623	0.714	2.	1.449	1.652	3.101	0.714	0.676	0.715
3.	1.536	1.422	2.956	0.692	0.622	0.712	3.	1.448	1.651	3.099	0.716	0.674	0.714
4.	1.540	1.422	2.962	0.694	0.621	0.711	4.	1.446	1.648	3.094	0.715	0.673	0.717
5.	1.538	1.426	2.964	0.693	0.625	0.709	5.	1.442	1.649	3.091	0.719	0.672	0.716
6.	1.539	1.424	2.963	0.697	0.626	0.706	6.	1.450	1.646	3.096	0.718	0.671	0.712
7.	1.540	1.419	2.959	0.690	0.620	0.716	7.	1.451	1.652	3.103	0.717	0.676	0.713
8.	1.543	1.420	2.963	0.694	0.624	0.715	8.	1.447	1.651	3.098	0.720	0.674	0.714
9.	1.541	1.422	2.963	0.692	0.624	0.714	9.	1.446	1.653	3.099	0.716	0.676	0.715
10.	1.540	1.421	2.961	0.693	0.620	0.711	10.	1.447	1.653	3.100	0.717	0.676	0.717
Mean	**1.540**	**1.421**	**2.962**	**0.693**	**0.622**	**0.712**		**1.447**	**1.650**	**3.098**	**0.715**	**0.674**	**0.715**
	Group IC						**Group ID**						
	Interabutment			**Intraabutment**				**Interabutment**			**Intraabutment**		
Model No	**RC**	**CL**	**RL**	**R**	**C**	**L**	**Model No**	**RC**	**CL**	**RL**	**R**	C	L
1.	1.540	1.540	3.080	0.680	0.730	0.621	1.	1.600	1.559	3.159	0.723	0.728	0.720
2.	1.541	1.543	3.084	0.678	0.728	0.625	2.	1.598	1.557	3.155	0.721	0.725	0.719
3.	1.543	1.540	3.083	0.680	0.729	0.626	3.	1.601	1.554	3.155	0.719	0.726	0.718
4.	1.542	1.538	3.080	0.682	0.732	0.624	4.	1.596	1.601	3.197	0.725	0.728	0.721
5.	1.540	1.540	3.080	0.681	0.731	0.623	5.	1.600	1.558	3.158	0.728	0.729	0.722
6.	1.539	1.536	3.075	0.679	0.730	0.619	6.	1.601	1.555	3.156	0.723	0.732	0.720
7.	1.538	1.542	3.080	0.676	0.726	0.620	7.	1.592	1.557	3.149	0.723	0.724	0.719
8.	1.540	1.541	3.081	0.678	0.730	0.624	8.	1.594	1.556	3.150	0.724	0.721	0.716
9.	1.536	1.543	3.079	0.680	0.731	0.621	9.	1.596	1.559	3.155	0.721	0.726	0.721
10.	1.542	1.540	3.082	0.681	0.730	0.620	10.	1.602	1.558	3.160	0.726	0.728	0.722
Mean	**1.540**	**1.539**	**3.080**	**0.679**	**0.729**	**0.622**	**Mean**	**1.598**	**1.561**	**3.159**	**0.723**	**0.725**	**0.719**

Table 4.3 Interabutment (RC,CL,RL) & Intraabutment (R,C,L) measurement of the stone dies obtained from the groupII (Virtual PVS Material) using four different putty wash technique.

	Group IIA						Group IIB						
	Interabutment			Intraabutment				Interabutment			Intraabutment		
Model No	**RC**	**CL**	**RL**	**R**	**C**	**L**	**Model No**	**RC**	**CL**	**RL**	**R**	C	L
1.	1.459	1.604	3.063	0.625	0.690	0.672	1.	1.541	1.557	3.098	0.628	0.673	0.709
2.	1.456	1.603	3.059	0.624	0.689	0.671	2.	1.538	1.555	3.093	0.627	0.674	0.701
3.	1.458	1.604	3.062	0.623	0.690	0.670	3.	1.540	1.556	3.096	0.629	0.676	0.708
4.	1.462	1.603	3.065	0.621	0.691	0.669	4.	1.539	1.554	3.093	0.626	0.671	0.706
5.	1.460	1.592	3.062	0.627	0.694	0.668	5.	1.541	1.557	3.098	0.630	0.672	0.707
6.	1.457	1.599	3.056	0.622	0.685	0.672	6.	1.539	1.554	3.093	0.631	0.675	0.709
7.	1.461	1.601	3.062	0.625	0.688	0.671	7.	1.542	1.555	3.097	0.628	0.676	0.708
8.	1.459	1.602	3.061	0.624	0.690	0.670	8.	1.546	1.557	3.103	0.625	0.673	0.709
9.	1.461	1.604	3.065	0.623	0.692	0.672	9.	1.542	1.559	3.101	0.627	0.672	0.709
10.	1.458	1.602	3.060	0.625	0.691	0.671	10.	1.541	1.557	3.098	0.626	0.671	0.706
Mean	**1.459**	**1.602**	**3.061**	**0.623**	**0.690**	**0.670**		**1.540**	**1.556**	**3.096**	**0.627**	**0.673**	**0.707**
	Group IIC						**Group IID**						
	Interabutment			**Intraabutment**				**Interabutment**			**Intraabutment**		
Model No	**RC**	**CL**	**RL**	**R**	**C**	**L**	**Model No**	**RC**	**CL**	**RL**	**R**	C	L
1.	1.559	1.509	3.068	0.620	0.688	0.650	1.	1.553	1.575	3.128	0.673	0.680	0.712
2.	1.558	1.507	3.065	0.622	0.687	0.649	2.	1.555	1.576	3.121	0.672	0.679	0.711
3.	1.557	1.506	3.063	0.621	0.688	0.648	3.	1.554	1.578	3.121	0.671	0.678	0.714
4.	1.556	1.508	3.064	0.619	0.686	0.650	4.	1.553	1.572	3.125	0.673	0.677	0.713
5.	1.559	1.509	3.068	0.614	0.688	0.652	5.	1.558	1.573	3.131	0.673	0.681	0.712
6.	1.558	1.510	3.068	0.624	0.689	0.653	6.	1.557	1.574	3.131	0.674	0.682	0.711
7.	1.559	1.509	3.068	0.620	0.684	0.650	7.	1.556	1.575	3.131	0.675	0.680	0.712
8.	1.558	1.507	3.065	0.621	0.685	0.652	8.	1.553	1.576	3.129	0.673	0.680	0.715
9.	1.559	1.508	3.067	0.620	0.688	0.653	9.	1.552	1.576	3.128	0.672	0.682	0.716
10.	1.559	1.509	3.068	0.622	0.687	0.650	10.	1.553	1.572	3.125	0.671	0.681	0.714
Mean	**1.559**	**1.507**	**3.066**	**0.620**	**0.687**	**0.650**	**Mean**	**1.554**	**1.574**	**3.128**	**0.673**	**0.680**	**0.713**

STATISTICAL ANALYSIS

The values were statistically analysed by using,

1) One way anova

2) Dunean's multiple range test

3) Student T test

ONE WAY ANOVA:

One way anova is employed to compare the means of 3 or more independent groups of observations. The observed variability in the samples is subdivided into 2 components.

a) Variability of the observation within a group about the group means.

b) Variability of the group means between group about the overall mean.

DUNCAN'S MULTIPLE RANGE TEST:

The mean of the all groups for each property evaluated was then compared by using Duncan's multiple range test calculated at 0.05% significant.

The Duncan's grouping is represented as alphabets in Superscript. Different alphabets denotes that values are significant at 5% level.

Student T test is done to compare two different groups.

<u>Table 4.4 Means and standard deviation of interabutments (RC, CL, RL) and intraabutment (R,C,R) (Occlusogingival) measurements on the master and stone models for the 4 impression techniques Group I (3M vinyl poly siloxane impression material)</u>

Location	*Master Model*		*Simultaneous 1 Step putty wash technique*		*2 Step putty wash poly ethylene Spacer Technique*		*2 step putty wash scrapping Technique*		*2 Step putty wash coping technique*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Right to centre	1.553	0.001	1.541	0.005	1.447	0.002	1.540	0.002	1.598	0.003
Centre to Left	1.607	0.001	1.422	0.002	1.651	0.002	1.540	0.002	1.557	0.002
Right to Left	3.160	0.02	2.963	0.005	3.098	0.004	3.080	0.002	3.154	0.004
Right	0.735	0.001	0.694	0.002	0.717	0.002	0.680	0.002	0.723	0.003
Centre	0.730	0.001	0.623	0.002	0.674	0.002	0.730	0.002	0.727	0.003
Left	0.737	0.001	0.712	0.003	0.715	0.002	0.622	0.002	0.720	0.002

Table 4.5 Means and standard deviation of interabutments (RC, CL, RL) and intraabutment (R,C,R) (Occlusogingival) measurements on the master and stone models for the 4 impression techniques Group II (Ivoclar vivadent virtual vinyl poly siloxane impression material)

Location	*Master Model*		*Simultaneous 1 Step putty wash technique*		*2 Step putty wash poly ethylene Spacer Technique*		*2 step putty wash scrapping Technique*		*2 Step putty wash coping technique*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Right to centre	1.553	0.001	1.459	0.002	1.541	0.002	1.558	0.001	1.554	0.002
Centre to Left	1.607	0.001	1.602	0.002	1.556	0.002	1.508	0.001	1.575	0.002
Right to Left	3.160	0.02	3.061	0.003	3.097	0.003	3.066	0.002	3.129	0.003
Right	0.735	0.001	0.624	0.002	0.628	0.002	0.620	0.003	0.673	0.002
Centre	0.730	0.001	0.690	0.002	0.673	0.002	0.687	0.002	0.680	0.002
Left	0.737	0.001	0.671	0.001	0.707	0.002	0.658	0.003	0.713	0.002

Table 4.6 - Percentage of deviation (%) and absolute change (μm) from master model of each impression technique – Group I (3M material)

Location	%	μm	%	μm	%	μm	%	μm
Inter preparation R-C	-0.773	-12	-6.825	-106	0.837	–13	2.898	45
Inter preparation C-L	-11.512	-185	2.738	-44	–4.169	– 67	–3.111	–50
Inter preparation R-L	-6.234	197	-1.962	-62	–2.532	– 80	–0.190	–6
Occlusogingival R	–5.578	–41	–2.449	–18	–7.483	–55	–1.633	–12
Occlusogingival C	–14.658	–107	–7.671	–56	0	0	–0.411	–3
Occlusogingival L	– 3.392	–25	–2.985	–22	–15.604	–115	–2.307	–17

Table 4.7 - Percentage of deviation (%) and absolute change (μm) from master model of each impression technique. Group II (Ivoclar Vivadent virtual material)

Location	%	μm	%	μm	%	μm	%	μm
Inter preparation R-C	-6.053	-94	-0.773	-12	0.322	5	0.064	1
Inter preparation C-L	-0.311	-5	-3.174	-51	–6.161	– 99	–1.991	–32
Inter preparation R-L	-3.133	-99	-1.994	-63	–2.975	– 94	–0.981	–31
Occlusogingival R	–15.102	–111	–14.558	–107	–15.646	–115	–8.435	–62
Occlusogingival C	–5.479	–40	–7.808	–57	–5.890	–43	–6.849	–50
Occlusogingival L	– 8.958	–66	–4.071	–30	–12.076	–89	–3.256	–24

<u>Table 4.8. Results of one way anova & Duncan multiple range test</u>

S.No	*Measurement*	*Technique*	*Group I (3M Material)*	*P value*	*Group II (Virtual Material)*	*P value*
1.	R-C	A	1.5412^{c}	<0.001**	1.4591^{a}	<0.001**
		B	1.4473^{a}		1.5409^{b}	
		C	1.5401^{b}		1.5582^{d}	
		D	1.5980^{d}		1.5544^{c}	
2.	C-L	A	1.4217^{a}	<0.001**	1.6024^{c}	<0.001**
		B	1.6508^{d}		1.5561^{b}	
		C	1.5403^{b}		1.5082^{a}	
		D	1.5571^{c}		1.5747^{d}	
3.	R-L	A	2.9629^{a}	<0.001**	3.0615^{a}	<0.001**
		B	3.0981^{c}		3.0970^{c}	
		C	3.0804^{b}		3.0664^{b}	
		D	3.1543^{d}		3.1291^{d}	
4.	R	A	0.6936^{b}	<0.001**	0.6239^{b}	<0.001**
		B	0.7169^{c}		0.6277^{c}	
		C	0.6795^{a}		0.6203^{a}	
		D	0.7233^{d}		0.6730^{d}	
5.	C	A	0.6229^{a}	<0.001**	0.6900^{d}	<0.001**
		B	0.6744^{b}		0.6733^{a}	
		C	0.7297^{d}		0.6865^{c}	
		D	0.7267^{c}		0.6800^{b}	
6.	L	A	0.7119^{b}	<0.001**	0.6706^{b}	<0.001**
		B	0.7150^{c}		0.7072^{c}	
		C	0.6223^{a}		0.6480^{a}	
		D	0.7198^{d}		0.7130^{d}	

The different alphabets denotes significant at 5% level.
** Significant at 1% level.

Table 4.9 Type A:
One step putty wash technique of 3M PVS & Ivoclar virtual PVS Material

	Group I		***Group II***		
	Mean	***SD***	***Mean***	***SD***	***P value***
Right to centre	1.541	0.005	1.459	0.002	< 0.001**
Centre to left	1.422	0.002	1.602	0.002	
Right to left	2.963	0.005	3.061	0.003	
Right	0.694	0.002	0.624	0.002	
Centre	0.623	0.002	0.690	0.002	
Left	0.712	0.003	0.671	0.001	

Note ** denotes significant at 1% level.

Table 4.10 Type B:
Two step putty wash Poly ethylene spacer technique of 3M PVS & Ivoclar virtual PVS Material

	Group I		***Group II***		
	Mean	***SD***	***Mean***	***SD***	***P value***
Right to centre	1.447	0.002	1.451	0.002	< 0.001**
Centre to left	1.651	0.002	1.556	0.002	
Right to left	3.098	0.004	3.097	0.003	
Right	0.717	0.002	0.628	0.002	
Centre	0.674	0.002	0.673	0.002	
Left	0.715	0.002	0.707	0.002	

Note ** denotes significant at 1% level.

Table 4.11 Type C:
Two step putty wash Scrapping technique
of 3M PVS & Ivoclar virtual PVS Material

	Group I		*Group II*		
	Mean	***SD***	***Mean***	***SD***	***P value***
Right to centre	1.540	0.002	1.558	0.001	< 0.001**
Centre to left	1.540	0.002	1.508	0.001	
Right to left	3.080	0.002	3.066	0.002	
Right	0.680	0.002	0.620	0.003	
Centre	0.730	0.002	0.687	0.002	
Left	0.622	0.002	0.648	0.008	

Note ** denotes significant at 1% level.

Table 4.12 Type D:
Two step putty wash Coping technique of
3M PVS & Ivoclar virtual PVS Material

	Group I		*Group II*		
	Mean	***SD***	***Mean***	***SD***	***P value***
Right to centre	1.598	0.003	1.554	0.002	< 0.001**
Centre to left	1.557	0.002	1.575	0.002	
Right to left	3.154	0.004	3129	0.003	
Right	0.723	0.003	0.673	0.002	
Centre	0.727	0.003	0.680	0.002	
Left	0.720	0.002	0.713	0.002	

Note ** denotes significant at 1% level.

Interpretation of the results:

Table 4.1 shows Interabutment (RC,CL,RL) & Intraabutment (R,C,L) measurements of the master model. Each distance on the master model at each measurement location was measured 10 times & the mean was used as the control to compare distance on the stone model obtained by the four impression techniques.

Table 4.2 shows the Interabutment (RC,CL,RL) & Intraabutment (R,C,L) measurement of the stone dies obtained from the groupI (3M PVS Material) using four different putty wash technique.

Table 4.3 shows the Interabutment (RC,CL,RL) & Intraabutment (R,C,L) measurement of the stone dies obtained from the groupII (Virtual PVS Material) using four different putty wash technique.

Table 4.4 shows the mean and standard deviation of inter & intra abutment of group I (3M PVS Material) The inter-abutment measurements of the stone die obtained using Group ID technique (2 step putty wash coping technique - Mean (RL) (3.154) was comparable to the measurements of the master model Mean (RL) (3.160). This was followed by Group IB technique 2 step (polyethylene spacer technique - Mean RL (3.098) and Group IC technique (2 step scrapping technique - Mean RL (3.080). The measurements of the stone obtained with group IA technique (one step technique - mean RL (2.963) showed significant difference from that of the master model dimension mean R-L (3.160).

The Intra-abutment measurement of stone die obtained from Group ID (2 step coping) putty wash technique mean - R (0.723), C(0.727), L (0.720) showed less dimensional changes in vertical direction compare to the dimension of master model R (0.735), C(0.730), L (0.737). The values obtained using Group IB (poly ethylene spacer technique) mean R (0.717), C (0.674), L (0.715) & Group IC technique (Two step scrapping technique) R (0.680), C(0.730), L (0.622) and Group IA technique (one step putty wash technique (R (0.694), C (0.623), L (.712) where significantly different from the measurements of master model Mean R (0.735), C (07.30), L(0.737).

Table 4.5 shows the mean and standard deviation of inter & intra abutment of group II (Ivoclar vivadent virtual material).The inter-abutment measurements of the stonedie obtained using Group II D technique (2 step putty wash coping technique - mean of RL (3.129) was comparable to the measurements of the master model mean of RL (3.160). This was followed by Group IIB technique (2 step (polyethylene spacer technique - Mean RL (3.097) and Group IIC technique (2 step scrapping technique - Mean RL (3.066). The measurements of the stone obtained with Group II A technique (one step technique - mean RL (3.061) showed significant difference from that of the master model dimension mean R-L (3.160).

The Intra-abutment measurement of stone die obtained from Group II D (2 step coping) putty wash technique mean - R (0.673), C (0.680), L (0.713) showed less dimensional changes in vertical direction compare to the dimension of master model R (0.735), C (0.730), L (0.737). The values obtained using Group II B (poly ethylene spacer technique) mean R (0.628), C (0.673), L (0.707) & Group II C technique (Two step scrapping technique) R (0.620), C(0.687), L (0.648) and Group IIA technique (one step putty wash technique (R (0.624), C (0.690), L (0.671) where significantly different from the measurements of master model Mean R (0.735), C (07.30), L(0.737).

Table 4.6 shows the percentage deviation and absolute change of group I (3M material)

The absolute change in (μm) inter & intra abutment measurements of the stone die obtained from Group I D technique (coping putty wash technique) RL (–6μm), R (–12μm), c (–3μm), L (–17μm) was comparatively less than all other techniques. Group I B (poly ethylene spacer technique) R-L (–62μm), R (–18μm), C(–56μm), L (–22μm), Group I C (scrapping putty wash technique) RL (–80μm), R (–55μm), C (0μm), L (–115μm). The one step putty wash technique showed maximum absolute change among all the techniques evaluated. RL (–197μm), R (–41μm), C (–107μm), L (–25μm).

Table 4.7 shows the percentage deviation and absolute change of group II (Ivoclar vivadent virtual material).

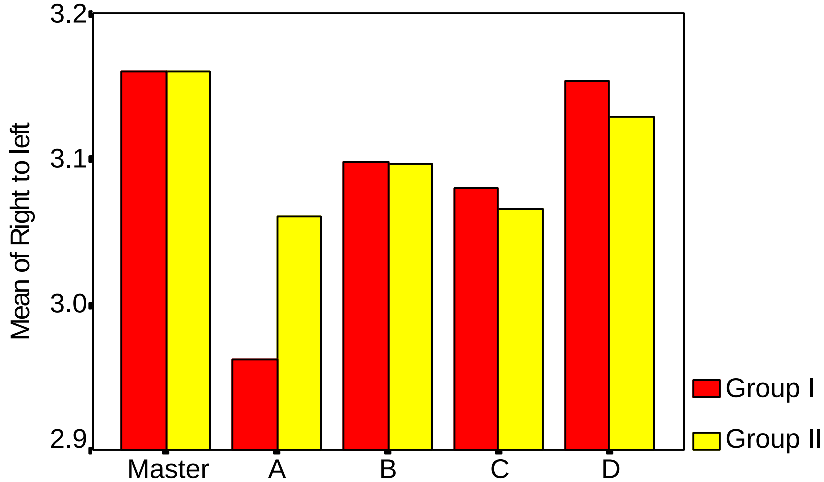
The absolute change in (μm) inter & intra abutment measurements of the stone die obtained from Group II D technique (coping putty wash technique) RL (–31μm), R (–62μm), c (–50μm), L(–24μm) was comparatively less than all other techniques. Group II B (poly ethylene spacer technique) R-L (–63μm), R (–107μm), C(–57μm), L (–30μm), Group II C (scrapping putty wash technique) RL (–94μm), R (–115μm), C (–43μm), L (–89μm). The one step putty wash technique (Group II A) showed maximum absolute change among all the techniques evaluated. RL (–99μm), R (–111μm), C (–40μm), L (–66μm).

Table 4.8 shows the one-way anova & Duncan's multiple range test results.P value < 0.001 reveals a significant difference at 1% level.Duncan grouping denoted by different alphabets in superscript shows significance at 5% level.

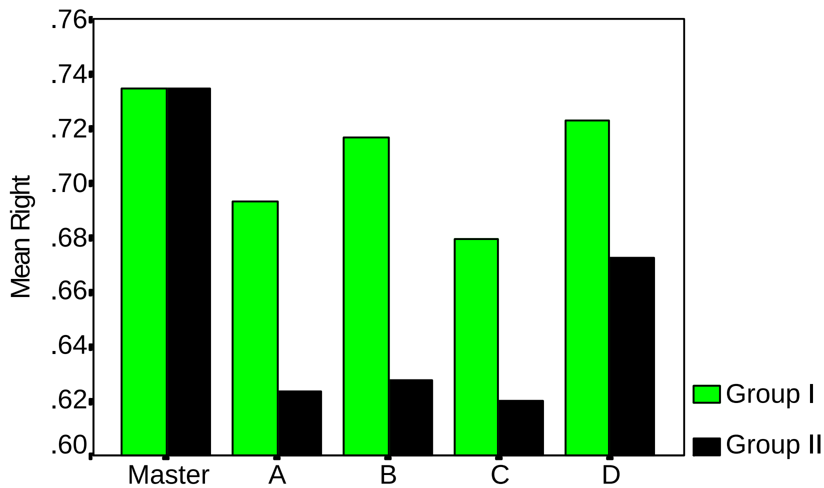
Table 4.9 – 4.12 shows the statistical analysis of student T test P value < 0.001indicates significant difference between two groups. P value >0.05 indicates that there is no significant difference between groupI & groupII.From the result and statistical analysis of this study it is concluded that there is difference between one step & two step technique, there is difference among two step technique and there is difference between two PVS material.

Dimensional Accuracy of 3M PVS & Virtual PVS material

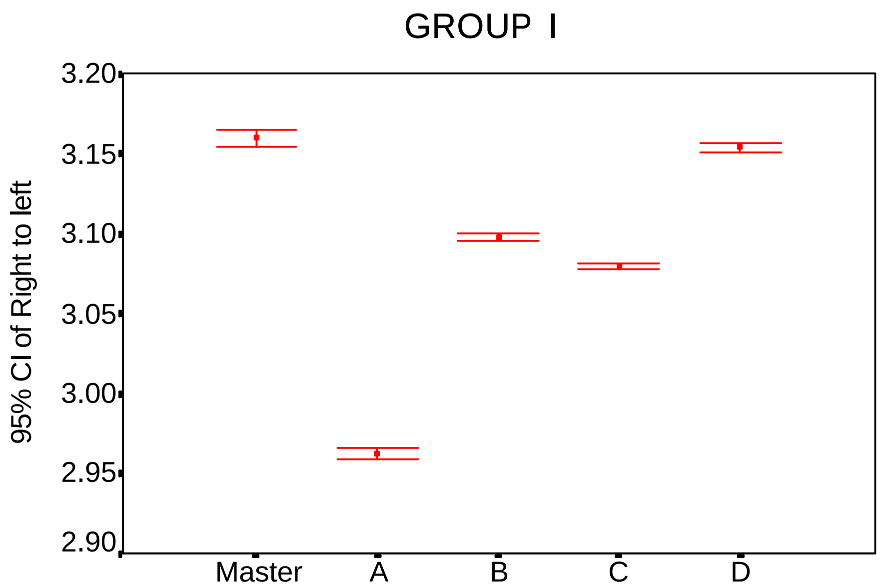
Mean of Right to Left

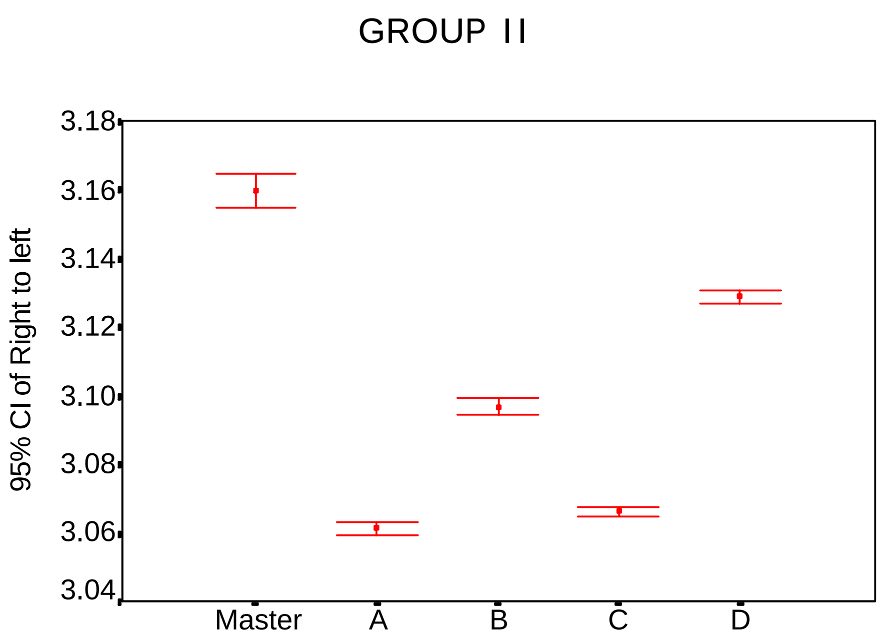


Mean Right



Dimensional Accuracy of Four Putty Wash techniques of 3 M PVS material at 95% Confidence Interval





DISCUSSION

Techniques, methods and materials are passing and changing, but underlying principles and fundamentals remain constant.

It must be remembered that any procedure, technique or material advocated for impression making, must be selected with the thought in mind of what will be the greatest good for the quality and greatest length of time[62].

Making a model or cast is an important step in prosthodontics and FPD’s in particular. Cast can be obtained from gypsum products using an impression mold which is the negative likeliness of a dental structure. In order to construct an accurate cast restoration, an accurate representation of oral structures is essential and this solely depends on the impression materials employed[80].

The viscosity and flow behaviour of the impression material control the ease of mixing, amount of air trapped during mixing, accuracy of reproduction of tissue details.

The working time, which begins at the start of mixing and ends just before the elastic properties have developed, must exceed the time required for mixing, loading the syringe/tray, injecting the material on tooth preparation and seating the tray.

Setting time can be described as the time elapsing from the beginning of mixing until the curing process has advanced sufficiently to allow retrieval of impression with minimal of distortion.

An ideal impression material showed accurately reproduce oral structures without distortion and dimensional change.

The viscoelastic properties of elostomeric impression materials play a major role in successful application as high accuracy impression materials. These materials are introduced into the mouth as viscous paste, which are then converted into viscoelastic solid at the end of setting reaction.

This viscoelastic property of elostomeric impression materials allows accurate reproduction of both hard and soft structures of oral cavity including the undercuts and interproximal spaces.

Among the elastomeric impression materials available poly vinyl siloxane are extremely popular because of their combination of excellent physical properties, handling characteristics and dimensional stability. They are available in various consistencies (light body, medium body, heavy body & putty) and are commonly used for fabrication of fixed restorations.

Several impression methods are followed with these impression materials. The most common are one step and two step putty wash technique. The putty wash technique was originally developed for condensation silicone to minimize the polymerization shrinkage and was later also employed for addition silicone.

Hung et al[39] used a variety of addition - type silicone impression materials to investigate the effects of technique and choice of material on accuracy and concluded that the choice of the material is important for the accuracy with addition silicone material.

T Jan et al[102] said that a variation expected when different brands of addition silicone materials are used.

Craig[46] stated that the choice of technique was the more critical factor. Based on the previous studies an in vitro study was conducted.

In 2 step technique the 1st step involves making of a putty impression followed by wash impression with a light body. In the 2nd step, the thick putty material is placed in a stock tray and preliminary impression is made. This results in what is essentially an intra oral custom made tray formed by the putty. Space for the light body wash material is provided by various means like scrapping, polyethylene sheet etc.

An alterative to the 2 stage procedure is the single stage procedure in which the wash material is syringed in to place and simultaneously putty loaded impression tray seated over the light body material in a single step. The main disadvantage with this one step technique is that the lighter viscosity putty material will displace less viscous wash material resulting in the reproduction of critical areas of the tooth preparation in putty rather than in light body.

This is the critical point to be considered because the putty is too viscous to replicate the required details. Moreover with this single step technique distortion (or) incomplete details reproduction can occur because of excessive pressure applied to the setting putty.

These distortions can also occur with the set putty used in 2 step technique. But in this technique the wash impression is carried out after the putty has set and contracted. The putty merely acts as a custom tray for light body the controlled wash bulk formed in the second stage compensates for the contraction of the putty with minimal dimensional changes. In spite of this, distortion can be expected in the 2 stage technique if the wash bulk can not be controlled. Uneven wash bulk produces differential compensation resulting in uneven dimensional changes.

In this study 2 poly vinyl siloxane impression materials (Group I 3M PVS material and Group II virtual PVS Material) were selected to evaluate the accuracy of one step and 2 step putty wash impression technique using various forms of spacers. Each group was divided into 4 subdivisions and they were named as (A,B,C,D)

Group IA, & Group II A represents - simultaneous one step putty wash technique.

Group I B & II B represents - two step poly ethylene spacer putty wash technique.

Group I C & II C represents - two step scrapping putty wash technique.

Group I D & II D represents - two steps 2 mm copping putty wash technique for two materials accordingly.

The accuracy of the impression materials was evaluated by comparing the ability of these materials to reproduce the details of a machined standard mild steel die simulating a 3 unit fixed partial denture. The die was scored with reference lines on the top and the axial surfaces of the abutment. The stone models were constructed from the impression made by the various technique explained above.

The accuracy of the material was evaluated by measuring the intra-abutment (R,C,L) and inter-abutment (RC, CL, RL) distances on the stone model and comparing these with the measurements obtained from the master model. The accuracy was evaluated using traveling microscope (suswax optic) capable of measuring upto 1 μm. The results were tabulated and were subjected to statistical analysis using one way anova, Duncan multiple range test & student T-test.

The results revealed significant difference between one step and 2 step putty wash technique.

Among the 2 groups tested group II showed less dimensional change with one step putty wash technique (Group II - 99 μm Group I - 197) than group I.

Group I showed less dimensional change with all types of 2 step putty wash technique than Group II.

Within the 2 step technique the prefabricated coping 2 step putty wash technique resulted in less dimension change (Group I: -6μm, Group II:-31 μm) followed by poly ethylene spacer technique (Group I: -62 μm, Group: - 63 μm) and scrapping technique (Group I:– 80μm, Group II: – 94μm).

All the 3 modes of 2 step putty wash technique used in this invitro study produced better results than one step technique.

The differences seen in 2 technique tested may be due t the difference in the wash bulk. In the one step technique employed in this study the putty material irrespective of 2 group tested displaced the wash material resulting in the die reproduction in putty medium rather than an wash medium. The uncompensated putty contraction may be the cause for the dimensional changes encounted with one step technique. This result is consistent with earlier studies by Chee and Donovan[29].

Though 2 step putty wash technique produced better results than one step technique, the wash bulk obtained with various forms of spacer produced a significant different within the various types of 2 step putty wash impression technique.

The 2 mm coping spacer technique (I D, II D) employed was most accurate as it produced complete control of wash bulk and thickness. Similar results were also reported by Nissan & Othes[68,69,70]. Standardized metal coping spacer created a uniform wash space which is very essential for a dimensionally stable impression.

In the poly ethylene spacer and scrapping method the wash bulk could not be controlled which allowed differential contraction resulting in uneven dimensional changes[45,46].

In discussion, the results of this in vitro study reveals that with one step technique group II (virtual PVS material) produced better result than Group I (3M PVS Material). In 2 stage technique Group I (3M PVS material) showed less dimensional changes for all the spacer techniques than Group II (Virtual). With the group II the customized coping showed improved results than the other spacer technique.

SUMMARY

A precise impression is necessary for fabricating an accurately fitting cast restoration. This is one factor that determines the restorations longevity. In this study two commercially available poly vinyl siloxane impression materials were selected.

Poly vinyl siloxane impression materials are extremely popular because of their combination of excellent physical properties, handling characteristics and dimensional stability. Its excellence clinical features remain unaffected if simple measures are guarded.

This study presents several impression techniques using 2 commercial available PVS and recommends, the one technique that provides the most accurate impression, utilizing the superior qualities of the PVS. The 2 materials used were 3 m Poly vinyl siloxane and ivoclar vivadent PVS. The impression technique which was used to find the accuracy was one step putty wash simultaneous technique, 2 step putty wash scrapping technique, 2 step putty wash poly ethylene spacer technique, and 2 step putty wash 2 mm coping technique.

The 2 PVS material was named as Group I and Group II. The technique were classified as Gr.IA, Gr.IB, Gr.IC, Gr.ID, Gr.IIA,

Gr.IIB, Gr.IIC, Gr.IID.GroupI represents 3M PVS material. Similarly Gr.IA represents one step putty wash simultaneous impression technique. Gr.IB represents 2 step putty wash scrapping technique, Gr.IC represents 2 step putty wash polyethylene spacer technique, Gr.ID represents 2 step putty wash 2 mm coping technique as mentioned above with Ivoclar vivadent material.

The accuracy of the impression technique was measured from the stone model using traveling microscope and compared with master model. One way analysis of variance (ANOVA) was used to compare the differences among the 4 putty wash impression techniques and the master model for each measurement. The results of the study showed that there was a significant difference between one step and 2 step putty wash impression technique.

In the one step impression technique, where no control of wash bulk and thickness exists, is considered to be the least accurate impression method. Furthermore, the direct contact between the less refined putty material and the tooth preparation, as well as the high prevalence of air bubble entrapment, seriously compromises restoration longevity.

The 2 stage impression technique has proved to produce the most accurate and reliable impression due to complete control of the wash bulk and thickness.

Among the 2 step putty wash impression technique like 2 step scrapping, 2 step polyethylene spacer and 2 step 2 mm coping technique, 2 step putty wash coping technique was the most accurate for fabricating restorations since in this technique 2 mm coping uniform bulk size prevents differential setting contraction and uneven dimensional changes. Using a “putty tray” at the first stage with a predetermined Space encircling the abutment will allow the wash to flow to its ideal uniform size at the second stage. Among the 2 polyvinyl siloxane impression material 3 M polyvinyl siloxane material produced better results with 2 step technique is accurate.Virtual PVS material showed comparatively better results in 1 step technique. From this study it is concluded that the 2 step putty wash impression technique with controlled bulk wash is essential for fabricating accurate stone dies.

CONCLUSION

Within the limitations of the study it can be concluded that;

1) There is significant difference existing between one step and 2 step putty wash impression technique.2 step putty wash method irrespective of spacer technique used produced more dimensionally stable dies than one step technique.

2) There is significant difference existing among two step putty wash impression technique when different spacers are used for wash material. 2 mm coping spacer for wash material produced stone dies with minimal dimensional change compared to other spacer technique.

3) Among the 2 PVS material 3M PVS material produced better results, with two step technique than virtual material.

4) Virtual PVS material showed comparatively better results in one step technique when compared to 3M PVS material.

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